

S Vichorek, Daniel N
621.4025 Ground source
E29gshp heat pumps

GROUND SOURCE HEAT PUMPS

Comfort and Efficiency for Montana Homes

STATE DOCUMENTS COLLECTION

APR 08 1996

MONTANA STATE LIBRARY
1515 E. 6th AVE.
HELENA, MONTANA 59620



TABLE OF CONTENTS



Page

- 1 -Introduction
4 -Craig and Jackie Taylor:
6 -Bob Wagner:
8 -Jim and Marleen Story:
10 -Charles Wroble:
12 -Steve and Tina Schwartzman:
14 -Mullan Trail Subdivision:
16 -Ken and Gail Clizbe:
18 -Gordon and Donna LaFournaise:
20 -Anton Hollinger:
22 -Wayne Scammon:
24 -Hugh Henderson:
26 -Kevin and Michelle Hadley:
28 -Frank and Peg Gebhart:
30 -Wayne and Barb Ristine:
32 -Stan and Bonnie Williams:
34 -J.W. and Jeannette Hammock:

DILLON
CARDWELL
CORVALLIS
STEVENSVILLE
STEVENSVILLE
MISSOULA
MISSOULA
MISSOULA
SEELEY-SWAN VALLEY
St. IGNATIUS
POLSON
KALISPELL
KALISPELL
KALISPELL
EUREKA
FORTINE

PUBLICATION STAFF

Project Coordination: Brian Green
Writing and Editing: Daniel Vichorek
Graphic Design: Don Howard

ACKNOWLEDGMENTS

This book could not have been produced without the cooperation and assistance of numerous individuals. We would like to thank all the homeowners who shared with us their experiences with ground source heat pumps. Extensive help throughout the publication process was provided by western Montana electric cooperative utility staff. We thank Ron Byrd, Buzz Alexander, Kirk Flynn, Jim Maunder, Joe Santos, Gary Mahugh, Ken White, Tim Engleson and Roy Nollkamper for their review and many helpful suggestions on improving this publication.

GROUND SOURCE HEAT PUMP INSTALLATIONS

We would also like to thank the following ground source heat pump contractors who installed the systems in this book and provided information on their installations; C&D Electrical and Heating in Dillon; Energy-Re/CON in Stevensville; Payne Technicians in Pablo; Denning Sheet Metal in Whitefish; Carson Brothers Inc. in Kalispell; Ground Source Systems Inc. in Kalispell and Central Heating and Cooling Inc. in Kalispell.

PROJECT FUNDING

Funding for this book was provided by the Bonneville Power Administration, Vigilante Electric Cooperative, Ravalli County Electric Cooperative, Missoula Electric Cooperative, Mission Valley Power, Flathead Electric Cooperative, Lincoln Electric Cooperative and Glacier Electric Cooperative.

Montana Department of Environmental Quality
Energy Division
January, 1996

Introduction

Some people say that the operating principle of ground source heat pumps reminds them of the story about the farmer who saw a giraffe for the first time and said: "There ain't no such animal." It has to be admitted that the ground source heat pump idea takes some getting used to: taking heat from the cold ground and using it to warm a house that is already a lot warmer than the ground.

Just Think Refrigerator

It seems less exotic if we remind ourselves that an ordinary household refrigerator, also operates by means of a heat pump, although it reverses the operation by transferring heat from the refrigerator to the air. Ground source heat pumps can work in reverse at the throw of a switch, providing air conditioning. Skepticism about ground source heat pumps is gradually retreating in Montana, where hundreds of systems are being installed each year and provide their owners with high quality comfort and economical operation. By "high quality," we mean that living space is kept at desired temperatures winter and summer with a system that is safe, quiet, and with none of the hot or cold spots characteristic of other systems. By "economical operation," we mean homeowners benefit from a system that offers the highest operating efficiency and lowest operating cost of any technology available today.

Hot Water Heating Too

Ground source heat pumps also offer benefits not found in other space heating/cooling systems. Besides providing high quality comfort, these systems can also supply a portion of the hot water heating in a home. This water heating feature, known as a hot water generator or desuperheater, can provide water heating whenever the unit is operating. Because a ground source heat pump is more efficient than a typical electric water heater, homeowners can save up to 50 percent on their water heating costs during the heating season.

Friendly to the Environment

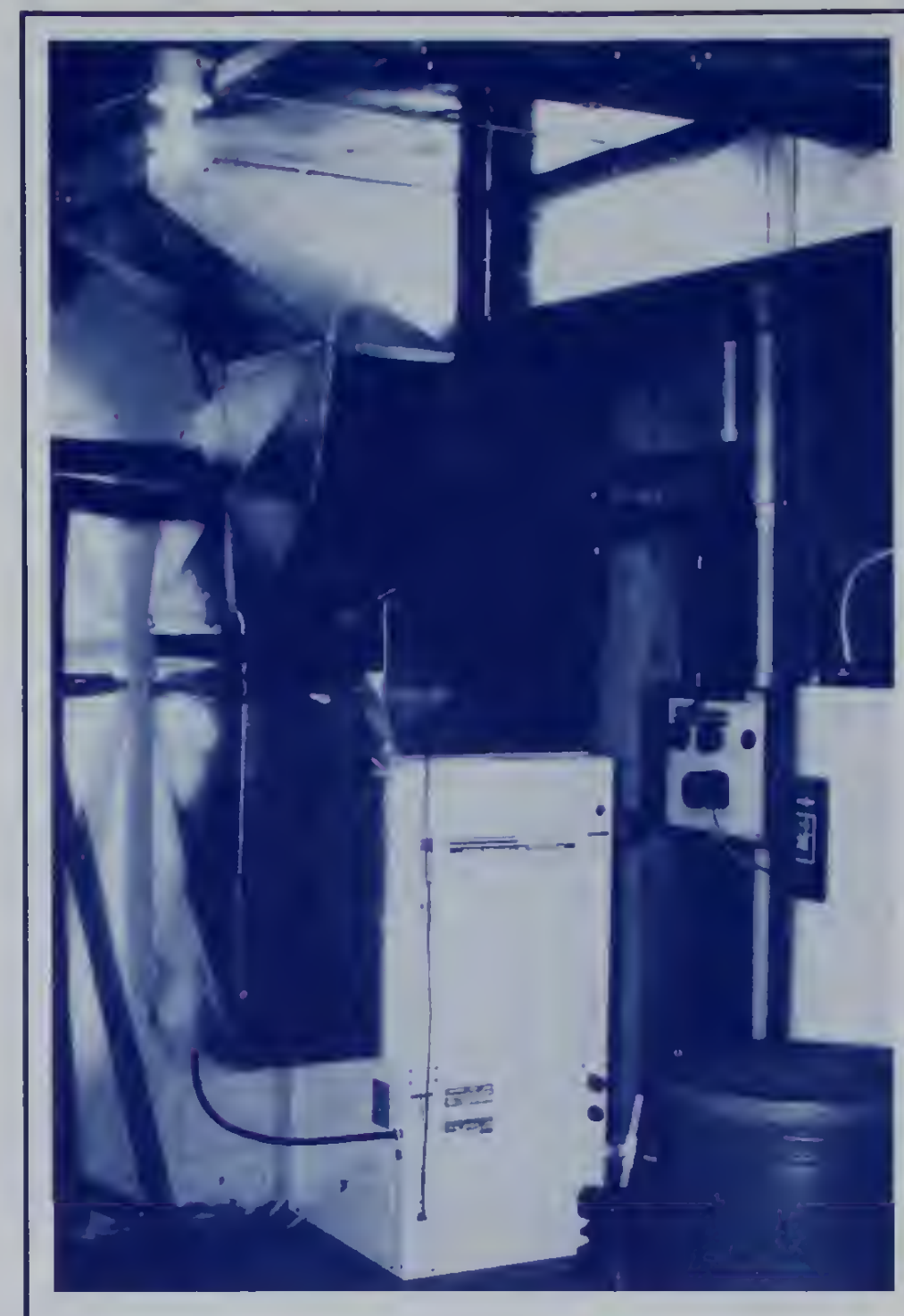
A purchase consideration that is becoming more important to many consumers today is selecting products that have a minimal impact on the environment. Residential space heating and water heating equipment is second only to automobile use as the largest contributor to greenhouse gas emissions in the U.S. today. In the case of combustion home heating systems, gas emissions occur at the homesite. Electric space heating systems, such as heat pumps, have no gas emissions at the homesite.

Ground source heat pumps have been identified by the Environmental Protection Agency (EPA) as causing the least emission of greenhouse gases of any currently available space heating/cooling equipment choice. Emissions result from the combustion of hydrocarbons to produce electricity. Because of these environmental benefits, EPA and the Department of Energy have collaborated on a new program to promote the use of ground source heat pumps across the country. The goal of the program is to boost yearly installations 10-fold by the year 2000. This effort will reduce carbon dioxide emissions by 25 million metric tons and tap a free and unlimited renewable resource, the earth's heat.

Montanans who value home comfort, low operating costs, and a desire to help improve the environment are increasingly choosing ground source heat pumps as their preferred home heating/cooling option.

GSHP For Short

Ground source heat pumps are known under several different and sometimes confusing names. You may hear someone refer to a ground-coupled or geothermal heat pump or even a water-source heat pump. These names all refer to the same basic equipment which we will refer to here as "ground source heat pumps" or simply "GSHP."



Ground source heat pump

Works in any House

It is easy to understand how GSHP operation is most economical in new, energy efficient houses with heavy insulation and minimum loss of heat to the outside, but they also have many advantages for older houses built with less insulation and relatively high heat losses. Older houses, which are sometimes uncomfortable, difficult to weatherize and costly to heat, are often prime candidates for a replacement heating system. When a GSHP replaces an existing system it can significantly lower monthly heating costs and provide the same even temperatures and comfort that are so greatly appreciated in new houses. People who have been heating with wood are particularly appreciative of GSHP, which

remove a major source of dirt and smoke from the house, along with the flame. Many homeowners who have installed GSHP place a high value on the safety aspects of their systems. No child has ever burned his or her fingers on a GSHP, which has no high temperatures. No house has ever burned down from a faulty GSHP chimney (GSHP have no chimneys). No one has expressed disappointment at no longer having to collect, store, and handle firewood after installing a GSHP.

Not Like the Old Heat Pumps

At this point we should mention that the GSHP of today are only distant relatives of the air-source heat pumps of past years, and have several notable differences. The main problem with older air-source heat pumps was a loss of efficiency at low temperatures. Very low temperatures cause air-source units to lose some efficiency when the outdoor heat pump unit goes through periodic defrost cycles. Unlike the continual change in outside air temperatures that can effect air-source heat pump performance, GSHP systems maintain high operating efficiencies because of stable ground temperatures. In addition, GSHP can deliver warmer supply air temperatures and all mechanical equipment is located inside the home. A properly sized and installed GSHP will keep you warm and comfortable during the coldest Montana winter.

How a GSHP Does What It Does

Although not many things seem colder than the ground in Montana during a typical winter, the ground nevertheless contains vast amounts of stored energy or heat absorbed from the sun throughout the entire year. Even if the air temperature is near zero degrees and the ground surface is frozen, a GSHP can take advantage of energy stored in the earth. Six feet below the surface temperatures range from 44 to 48 degrees F. across western Montana. This heat source obviously cannot heat our homes directly. Heat pump technology, however, can take warmth from this excellent "low-temperature" heat source, concentrate it, and raise it to 100 degrees F. or more inside the home.

The heat transfer process is accomplished by circulating a fluid, a mixture of water and a dilute anti-freeze solution, through high density polyethylene pipes buried in the ground. The buried pipes, often called ground loops, act as heat exchangers between the ground and the heat transfer fluid. In winter, the heat transfer fluid is colder than the ground surrounding the pipes and picks up heat from the earth. After circulating through the ground loop and picking up heat, this fluid is pumped back to the indoor GSHP unit. Inside the home a second heat exchanger coil extracts heat from the ground loop, cooling

the circulating fluid from the ground loop 4 to 5 degrees F. in the process, and warming an environmentally safe refrigerant. A compressor then concentrates heat from the refrigerant, using the same mechanical process as your kitchen refrigerator, raising its temperature substantially. The last stage in the process is unglamorous and familiar to everyone, namely the distribution of warm air throughout the house with conventional ductwork.

The Reverse Is Also True

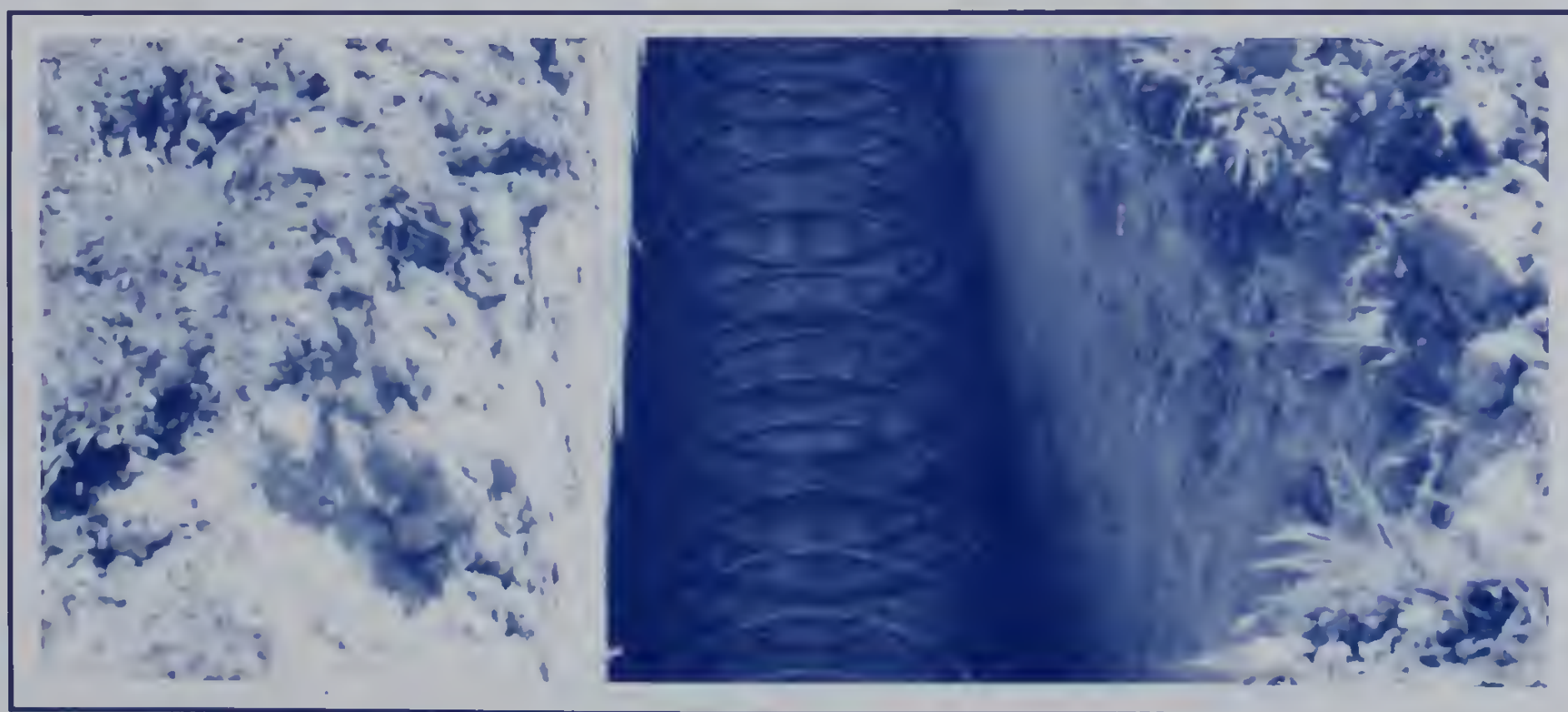
For air conditioning, the system runs in reverse, taking heat from the living space and transferring it to the ground. In the air conditioning mode, the system also can heat hot water needed in a house, saving the homeowner on water heating costs as a by-product of GSHP operation.

A COP When You Need One

The efficiency of a GSHP is expressed as Coefficient of Performance, abbreviated COP. A detailed study of the GSHP performance in 40 Missoula homes showed that these systems have an average COP of 2.8, meaning that for every kilowatt of energy put into the system (as electricity to run pumps, compressor, and fans) 2.8 kilowatts of heating or cooling are obtained from the system. It could be said that such a system is 280 percent efficient. Newer GSHP systems, which feature improvements such as multi-stage compressors, offer even higher operating efficiencies.

Different Loops for Different Lots

There is some variation among GSHP systems in the configuration and function of the heat exchanger or ground loop. For example, most systems are "closed loop," meaning the same heat transfer fluid circulates through the loop indefinitely, but a few are "open loop." An example of an open loop system is included in this publication, at the home of Bob Wagner near Cardwell. In Wagner's system, water from a spring is passed once through the GSHP and then returned to the outflow from the spring. Opportunities for this type of operation are limited in Montana.



Typical horizontal ground loop installation

Closed loop systems come in various configurations. The most common is a horizontal system, with the heat exchanger or ground loop buried horizontally. Ground loops are laid in several different trenches, each 4-6 feet deep. The length of the ground loop will vary according to the heat loss rate of a particular house. Other systems have vertical loops, in which a well drilling type rig bores uncased vertical holes in the ground. A U-shaped polyethylene pipe, 3/4 - 1 inch in diameter, is then permanently placed in the hole and grouted or sealed to ensure good heat transfer. Houses with a vertical ground loop will usually have several different bore holes depending on the heat loss rate of the home. These two closed loop designs both use the same high-strength polyethylene pipe and special heat fusion fabrication techniques to prevent any leakage during the life of the system.

Another variation of the horizontal system has its loop installed under water, such as in a pond or lake. This type of design is also a closed loop system. Bodies of surface water are efficient collectors of solar energy and provide a ready source of heat for houses.

Durable and Reliable

Another question about GSHP relates to their durability. Experience in Montana and elsewhere indicates low maintenance requirements. The major operating components, such as the compressor and blower motor, have refrigerator-like durability. The heat exchanger or ground loop tubing is very durable and long lasting, and often comes with a 50-year warranty against leakage or defects.

Short-Term or Long-Term Viewpoint

It is no secret that GSHP have a higher initial cost than other heating and cooling system choices. Homeowners who have installed these systems have not ignored the consideration of initial costs in their decision making criteria. Instead, they often look at the value derived from their investment. The concept of value involves

measuring the increased initial costs against the increased benefits they receive. The increased benefits are greater home comfort and operating savings. Increased safety and environmental benefits also are a factor.

Less Taxing Too

When tax season rolls around many GSHP owners are smiling. Why? Because they will reap another benefit from their heating and cooling system choice, a reduced tax bill. GSHP systems are eligible for a special Montana income tax credit of \$1,000. This credit is taken over a 4-year period, reducing your tax bill by \$250 each year.

What This Book Is About

In the Big Sky Country we often seek out the opinions and real life experiences of others when we have questions about something we are unfamiliar with ourselves. Since the majority of us have never lived in a house with a GSHP, it seemed appropriate to gather the experiences and opinions of Montanans who actually do live in such houses. To accomplish that, 15 families were interviewed and asked to share their personal experiences concerning GSHP with other Montanans. Those interviewed live in a variety of houses that vary in size, age and energy efficiency. However, all the homeowners gave their GSHP high marks for comfort and performance.



This lake loop heat exchanger will be sunk in the water to serve as the heat source for a GSHP system.

KEY FACTS

OWNERS: Craig and Jackie Taylor

LOCATION: Dillon

HOME SIZE: 4,000 square feet

UTILITY: Vigilante Electric Cooperative

HEATING/COOLING COSTS:

Monitoring Period
March 94 - March 95
\$223 (@ 4.5¢ per kWh)

SYSTEM TYPE:

Horizontal Ground Loop

Craig Taylor is a professional builder who has built a lot of houses. When it came time to build his own house, he decided to equip it with a GSHP system for heating and cooling, along with a Super Good Cents insulation package and an exhaust air heat pump for water heating and ventilation.

Skeptical at First

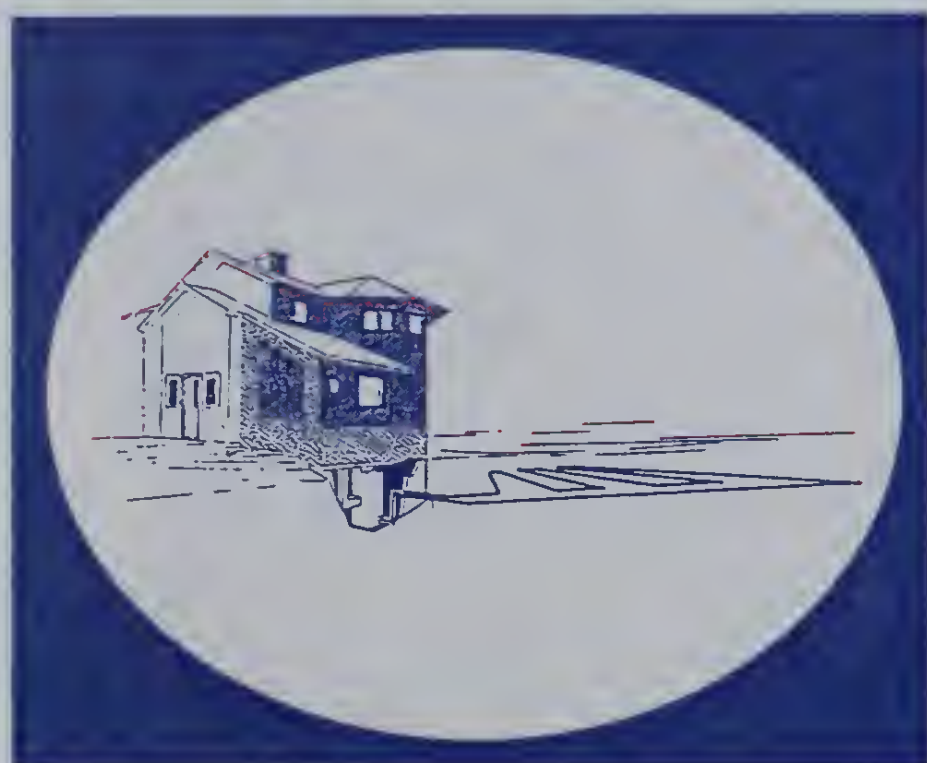
"I was skeptical at first, but now I'm impressed," Taylor said. At the time of his interview, Taylor's system had been in operation for a little over a year, and electric bills for the GSHP and everything else in the house had yet to exceed \$100 a month. "And that includes the electric stockwater heaters that we operate in the winter," Craig said. "Five of us live here, and we keep the thermostat at 70 degrees year-round."

Craig said the heat in his house is much more even than in a similar Super Good Cents House that he built and heated with electric baseboard heaters. Some things about the GSHP are deceptive, he said. For example, he noted that his GSHP doesn't move a big volume of air, but keeps the whole house warm with a gentle, silent infusion of warm air. Unlike some forced air heaters, Taylor said, the GSHP doesn't come on with a big blast of cold air.

The Taylor's GSHP is "ground coupled," meaning it gets its heat from the ground. This particular system operates with the heat picked up by a heat transfer fluid circulating through 4,200 feet of plastic pipe laid horizontally in 350-foot trenches. Each trench has four pipes 2 feet apart. The trenches were supposed to be 6 feet deep, but some of them wound up being closer to 8 feet, which probably slightly enhanced the heat pump operation.



A ground loop, located in the backyard of the Taylor home, moves heat stored in the earth to the GSHP unit inside the home.



No Ground Too Cold

Located in the open country north of Dillon, the Taylor house is located on ground which does not appear to contain a good deal of warmth, especially when covered with ice and snow in the winter with a brisk wind off the mountains. Nevertheless, heat pump technology can get heat even out of this ground. During its first year of operation, the Taylors' GSHP kept their 4,000 square foot home warmed and cooled for approximately \$260. At this rate, Craig pointed out, the savings will pay for the GSHP in time, even though the system was more costly than other systems to begin with. The payback period will shorten as the cost of alternative fuels rise, as they continue to do, he said.

"GSHP systems are for the long run," Taylor said. As time goes by, he noted, propane and other fuels are going to cost more, while the cost of operating a GSHP will only increase with the relatively small increases in the price of electricity.



Craig Taylor (left) and his GSHP installer are both pleased with the performance of his GSHP system.

Craig and Jackie Taylor - Dillon

" I was skeptical at first, but now I'm impressed "

Craig Taylor



KEY FACTS

OWNER: Bob Wagner

LOCATION: Cardwell

HOME SIZE: 4,500 square feet

UTILITY: Vigilante Electric Cooperative

SYSTEM TYPE:
Open Loop

For Bob Wagner, installation of a GSHP to heat and cool his new house in the hills near Cardwell was part of a well-thought-out plan to save money and resources. Before building his house, he monitored the temperature of a warm spring on the property for a year. He found that even in the winter, the water remained at 65 degrees, which made it a very good medium for operation of an open loop water-source heat pump. A shallow well tapped into the warm water provides a steady source of warm water which is plumbed into the Wagner house, passes through the heat pump, and back into the creek.



Bob Wagner and his open loop GSHP system.

A Rare Advantage

Operating his heat pump with warm water gives Wagner a rare advantage that normally is not available to home owners. Instead of having to drill wells or bury hundreds of feet of pipe to pick up heat, Wagner had only to put in a short length of pipe to bring the water to his heat pump.

Paid for Itself in Short Order

Wagner calculates that he will recoup the cost difference between the GSHP system and his alternative choice, a high-efficiency propane furnace, in only a few years. This quick payback occurs because Wagner's system did not incur costs associated with trenching a ground loop or drilling a well, thus reducing his installed costs by 25 to 30 percent.

So far, the highest monthly bill for operating the system has been \$98 and that was for January 1994, a month when temperatures sank near 40 degrees below zero. The auxiliary electric heater incorporated into the heat pump came on for three or four days during the very cold weather, driving up the bill. The Wagner house is approximately 4,500 square feet on three floors, and the heat pump keeps the entire space at 70 degrees 24-hours a day. Wagner said there is no advantage to turning the heat down at night.

Works for Air Conditioning and Water Heating Too

For air conditioning, Wagner turns a valve to bring 45 degree water into the heat pump from the domestic water well. The cooler water makes the system more efficient for air conditioning. A third function of the heat pump is to heat water for domestic use. Wagner said the



BOB WAGNER - CARDWELL

heat pump provides nearly all the hot water needed by his family, which includes his wife and four children. The regular water heater rarely comes on. He figures he saves \$20 a month in water heating costs alone.

Heating and cooling the Wagner house is made easier by adherence to Super Good Cents standards in construction. The walls were made with 8-inch panels of foam sandwiched between plywood sheets, rather than conventional stud walls. The upstairs ceiling has 22 inches of cellulose insulation, windows are argon-filled with low-e glass. Many other energy efficiency features were installed throughout the house.

No Fire in the House

Safety is another consideration. Wagner pointed out that the lack of any flame in the building cuts the chance of a house fire and prevents any danger from carbon monoxide.

Anyone considering installing a GSHP would be well advised to consider the long-term consequences, Wagner said. Even though his warm water spring gives him a slight performance advantage over most other

people who might install a GSHP, he said he could pay back the cost of a typical GSHP system, which uses a ground loop heat exchanger, within a reasonable time period.

The key to saving energy, he said, is to educate people to the advantages of efficiency. Take taxes for example. The money saved with low heat bills is just like regular income, Wagner said, and the best part is they can't tax it.

" Saving energy is just common sence"

Bob Wagner

A Pile of Common Sense

Saving energy is just common sense, Wagner said. "It makes a pile of sense. Nobody can afford to waste anymore."

Economical operation is not the only advantage of a GSHP system and a well insulated house, according to Wagner. He said that the quality of heat provided by the GSHP is better than the alternatives. The GSHP is silent, he said, and the gentle flow of warm is air is not perceptible unless a hand is placed in front of the register. Wagner contrasted the GSHP operation to conventional forced-air heating, which he said always creates a draft. With the GSHP, every room in the Wagner house gets heated evenly, with no cold spots.



KEY FACTS

OWNER: Jim and Marleen Story

LOCATION: Corvallis

HOME SIZE: 2,000 square feet

UTILITY: Ravalli County
Electric Cooperative

**HEATING/COOLING
COSTS:**

Monitoring Period
August 93 - August 94
\$145 (@ 4.5c per kWh)

SYSTEM TYPE:

Horizontal Ground
Loop

For Jim Story, the decision to install a heat pump in his house was a matter of environmental responsibility. Besides providing high quality heating and cooling, the heat pump system helps break man's exploitation of the earth, Jim said, adding, "I sure believe in it."

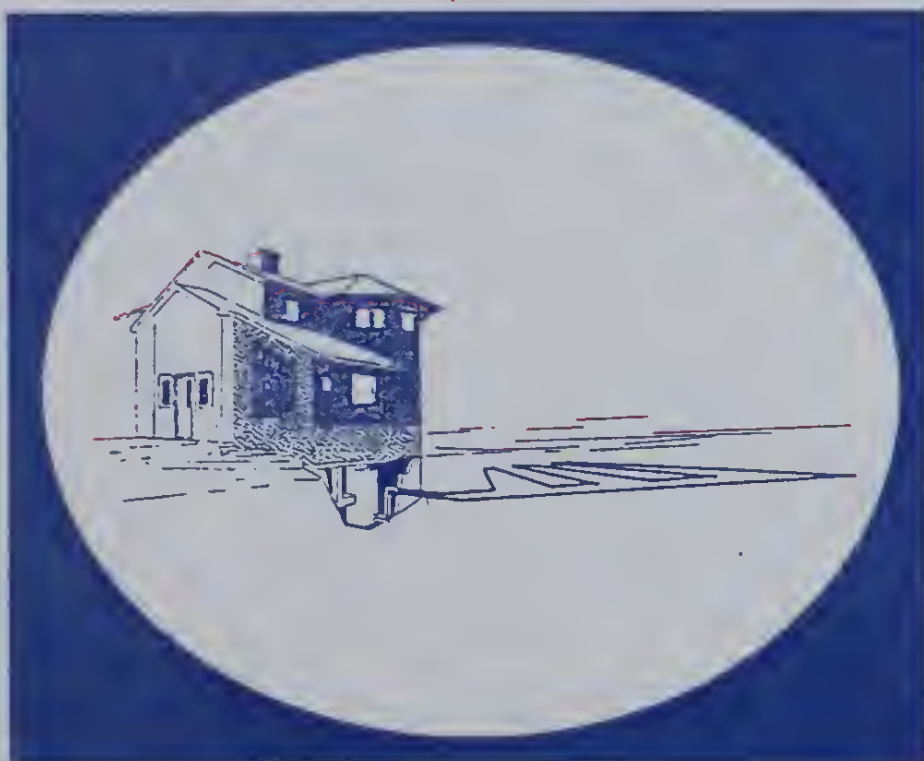
Jim's family, including his wife and two kids, has been living in the Story's 2,000 square foot house since July of 1992. Jim said his highest heating bill was \$39.00 for a cold January in 1994. Heating costs averaged only \$34 a month during December, January, and February that winter.

Didn't Just Jump into It

The decision to install a heat pump was not something he just jumped into, Jim said. He said he went to considerable lengths looking into various systems, and despite the high initial cost, decided a heat pump was the way to go. "I didn't want to heat with wood," he said. "I wanted something more environmentally compatible." He pointed out that a heat pump emits no pollutants and uses no nonrenewable resources. Wood heat also uses a renewable resource, but produces air pollution and is dirty to use, he said, and predicted that the use of wood will become more environmentally restricted with time.



Jim Story's ground source heat pump keeps the family comfortable year-round and provides the satisfaction of using resources wisely.



An Underground Operation

The Storys' heat pump is a closed loop system, operating on heat picked up from the earth by an antifreeze solution circulating in pipes buried in three 100-foot trenches.

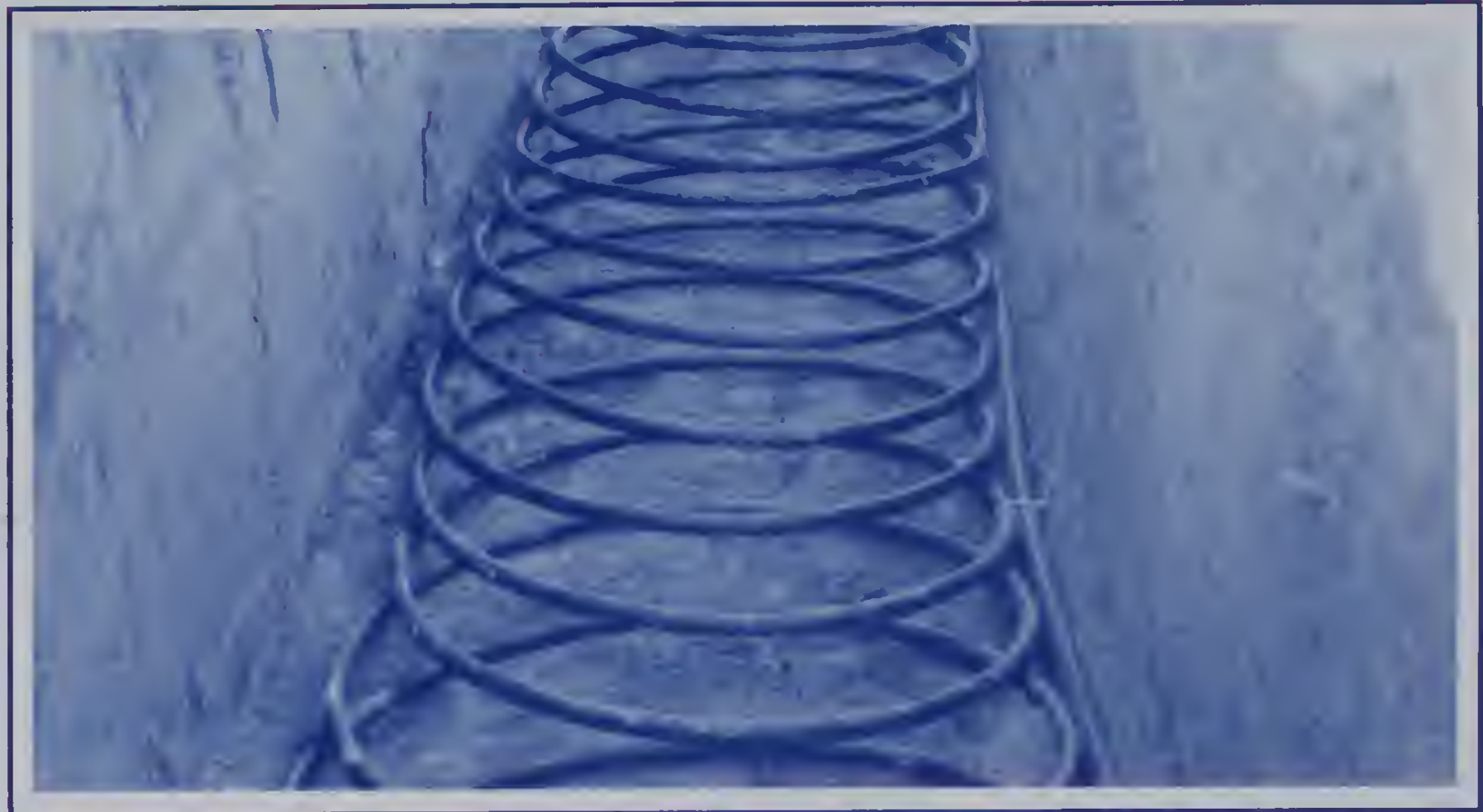
The heat pump is an ideal system, Jim said. "If you pro-rate it over the long term, it will pay off." He pointed out that all forms of energy are going to get more scarce in the future, and the small amount of electricity used by a heat pump will make it relatively more economical to operate as other forms of energy get more costly.

Energy Efficiency and A View Too

Jim said the Super Good Cents insulation level in his house (R-26 in the walls, R-60 in the ceiling) would keep it warm for some time during any power outage, which can happen occasionally. Heating also would be provided by large windows on the south side of the house, which collect solar warmth besides providing a fine scenic view of the Bitterroot Valley.

All in all, Jim said, the only drawback of GSHP is the higher initial cost than other heating systems, but even this should not necessarily stand in the way. "The co-op gave me a cash incentive to put it in, but I would have put it in anyway."

JIM AND MARLEEN STORY - CORVALLIS



A closed loop heat exchanger, buried below the frost line, allows a ground source heat to transfer energy from the earth to the home during the winter.

"I sure believe in it."

Jim Story



KEY FACTS

OWNER: Charles Wroble

LOCATION: Stevensville

HOME SIZE: 2,400 square feet

UTILITY: Ravalli County Electric Cooperative

SYSTEM TYPE:
Pond Loop

When he found himself over 70 years of age, Charles Wroble decided he was getting too old to heat with wood. He had electric baseboard heaters to supplement the wood in his 2,400- square foot house, and one year he decided to see if the electric heaters could heat the house by themselves. They did, but high heat loss in his lightly insulated older house resulted in utility bills as high as \$275 a month.

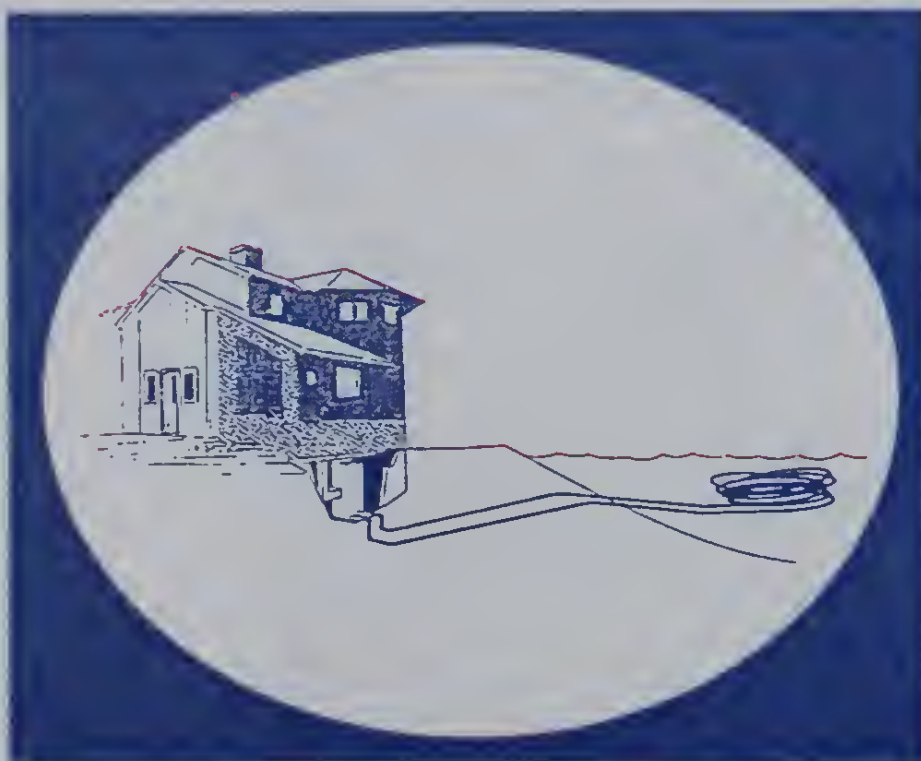
Pond Provides Fish, Warmth

The high bills set Wroble on a search for a more economical heating method. Ultimately, he decided to have a GSHP system installed. Wroble's property was well-suited for GSHP use because of a 2-acre pond that he had built next to the house some years earlier. This pond is 11 feet deep, never freezes to the bottom, and is an excellent source of renewable energy that can be tapped with heat pump technology. The installation includes 2,700 feet of 3/4 inch coiled pipe in the bottom of the pond to provide a source of heat to the GSHP. Wroble also had the house fitted with \$2,700 worth of insulation to complete his move towards energy efficiency.

Bills to Grin At

Now in his third year with the GSHP, Wroble smiles at his bills for heating and cooling. "They run just about \$56 a month year-round," he said, adding, "The convenience is unbelievable." Besides reasonable bills, Mr. Wroble no longer has to put up with the negative aspects of wood heating, such as ash, soot and dirt. Replacing wood heat with a GSHP system "takes a lot of burden off you," he said.

Mr. Wroble has his own unique source of ventilation that most GSHP owners probably would be reluctant to copy. "I'm kind of a screwball," he said. He explained that he keeps his bedroom closed off from the rest of the house, and opens the door from the bedroom to the outdoors while he sleeps, every night of the year. In the morning, he closes the door to the outside and opens the bedroom to the rest of the house, providing a source of fresh air. He also leaves the front door open for 45 minutes every morning while he exercises. "It cools the front of the house right down," he said. "I've got a plant in my hallway there that I've frozen half a dozen times but it always comes back."



"The convenience is unbelievable."

Charles Wroble

Warm Toes in the House

Mr. Wroble said the GSHP provides all the comfort that could be imagined. "I never wear shoes in the house, and I'm comfortable all the time" he said. Two students who board with Wroble do their homework on the floor, he said.

A Heat Pump Will Not Cook a Turkey

Despite his fondness for the GSHP system, Mr. Wroble still has two wood stoves in his house. One is a cook stove of long service that sometimes gets used to cook holiday dinners for 70 or so members of the extended Wroble clan and their friends, and the other is a heating stove. "I've still got it in case somebody runs off the road when it's 30 below zero and takes out half a dozen power poles," he said.

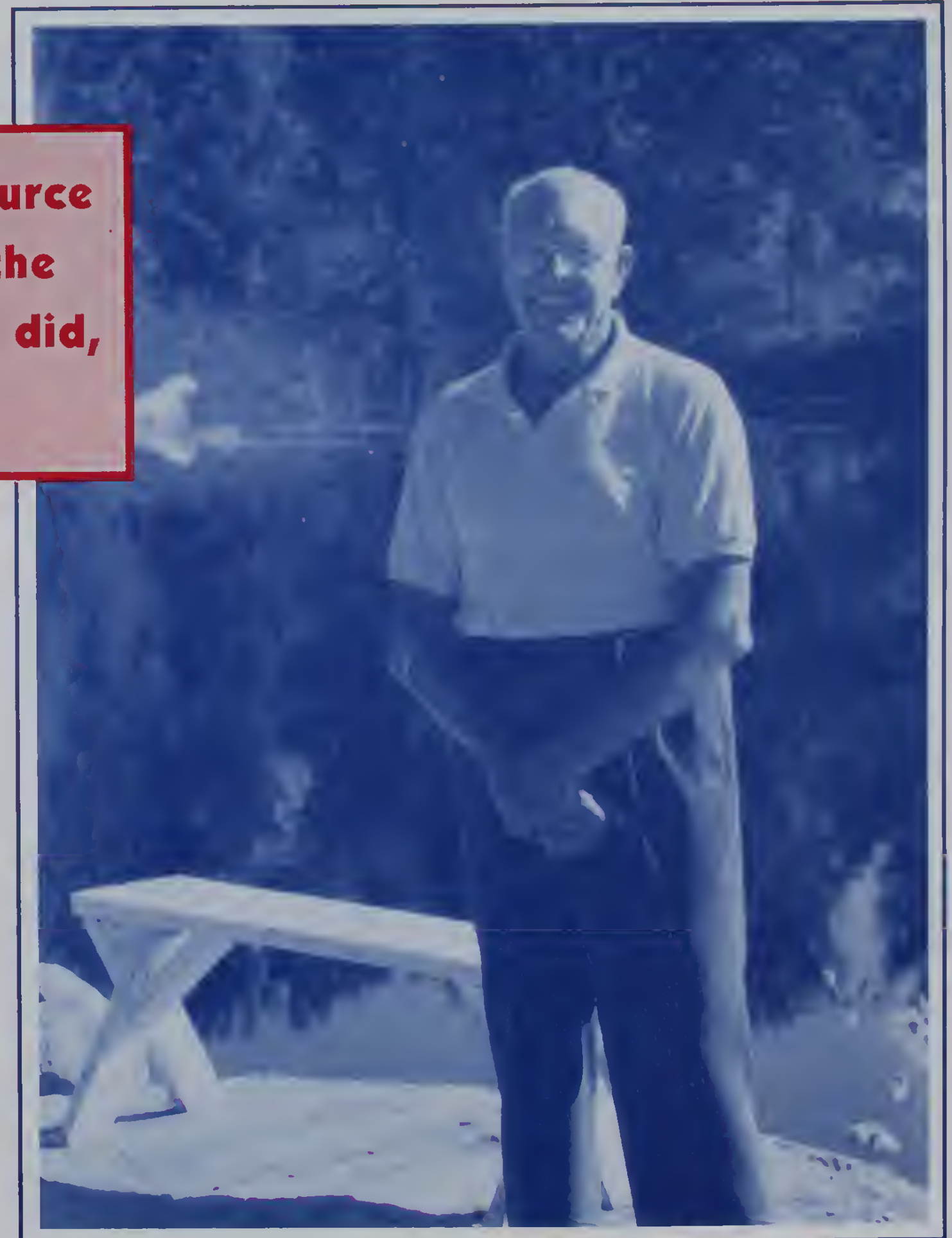
Word got around about Mr. Wroble's GSHP system, and people come to ask him about it. He tells them they should have one. "I expect they've got them by now."



This tranquil pond is both a source of enjoyment and heat for the Wroble home.

CHARLES WROBLE - STEVENSVILLE

**" The Ground Source
Heat Pump was the
best thing I ever did,
believe me."**



KEY FACTS

OWNERS: Steve and Tina Schwartzman

LOCATION: Stevensville

HOME SIZE: 3,280 square feet

UTILITY: Ravalli County
Electric Cooperative

**HEATING/COOLING
COSTS:**

Monitoring Period
August 94 - August 95
\$210 (@ 4.5¢ per kWh)

SYSTEM TYPE:
Horizontal Ground
Loop

Steve and Tina Schwartzman gave up the romance of wood heat when they moved into their new house in 1993. Tina said it was not that hard to give up. The dirt and dust and smoke associated with wood heat were not only a sanitation problem but a health hazard, Tina said. The family noticed an increased incidence of respiratory problems and their son developed allergies.



Goodbye to the Romance of the Wood Stove

Clearly, it was time to look for something better. Rather than sink a lot of money into the log house they had built in 1980, they decided to build a new house to Super Good Cents insulation standards, with a ground source heat pump for heating and cooling.

Their new house is 3,280 square feet on two levels, and every square foot is comfortable living space all year long. "This is the most comfortable house I've ever lived in," Steve said. "It can't be beat for comfort."

One of the recognized advantages of GSHP is the evenness of heating and cooling that they provide throughout the living space. The cold spots and hot spots found in conventionally heated houses are missing in houses with GSHP.

"This is the most comfortable house I've ever lived in."

Steve Schwartzman



A Breath of Fresh Air

Steve contrasted his house with other large houses that are only partially heated in the winter. "People sometimes build big houses and then they have to close part of them off during the winter because they can't afford the heat bill," he said.

The heat pump also provides cooling, but the Schwartzmans' heavy insulation (R-57 in the ceiling, R-38 in the walls) makes this unnecessary except for the rare 90-degree day, Steve said. The air-to-air heat exchanger also contributes substantially to the indoor environment, Tina said. "In the summer when the forest fires are burning and the valley is full of smoke, I like to come into the house for a breath of fresh air."



STEVE AND TINA SCHWARTZMAN - STEVENSVILLE

Year-Round Comfort

In the Schwartzman house the GSHP, in combination with the air-to-air-heat exchanger and Super Good Cents insulation, provides year-round comfort with no combustion of any kind, and only a small amount of electricity needed to operate the system. The total heating and cooling costs for the Schwartzman's first year in their house, August 1993 to August 1994, were \$233 dollars, an average of less than \$20 a month. Steve said the bills for the elapsed portion of the second year were nearly exactly the same as those from the same period in the first year. Additional savings were provided by the system's contribution to domestic water heating, though this figure is not known.

Except for the need to change a filter occasionally, the system generally operates without any maintenance. "It operates on the same principle as a refrigerator," Steve said, "and it should last as long as a refrigerator lasts."

No More Ice-Covered Logs

Having got past these obstacles, the Schwartzmans have a clean, comfortable house with heating bills that anybody would envy, and no need to roll ice-covered logs around in the middle of the winter, maintain flames in their house, or breathe polluted air. Anyone contemplating purchase of a heating system should compare the benefits.



MULLAN TRAIL - Missoula

A Ground Source Heat Pump Subdivision



Although the advantages of ground source heat pumps have been known to land developers and others for years, they are more expensive than other systems and until quite recently, were usually regarded as an option for the rich.

This perception has begun to change in western Montana, in large part because of a demonstration project carried out by the Missoula Electric Cooperative, the Bonneville Power Administration (BPA), land developer David Theisen, and Tony Smith, a GSHP installer. At the request of the co-op, BPA agreed to provide a subsidy to install GSHP in 40 houses that were to be built in a subdivision developed by Theisen on the west side of Missoula. In return, the co-op and BPA would conduct extensive monitoring efforts to determine the energy performance and savings from GSHP technology.

A Choice of 27 Plans

This became the Mullan Trail Ground Source Heat Pump Demonstration Project. Lot purchasers had a choice among 27 different house plans, with each house to be heated and cooled with a GSHP and built and certified to Super Good Cents insulation and energy efficiency standards. Thiesen decided that the GSHP in the demonstration project would use vertical loop heat exchangers to minimize ground disturbance. A drill rig was brought in to make these installations all at once. Savings resulted from the well drilling rig having to make only one trip and to move only short distances among drill sites on different lots.

Construction of the first house in the subdivision began in April 1993, and 40 houses were built in the first year.

By early 1995 when interviews were conducted for this publication, 50 houses with GSHP were accumulating an impressive record of low cost comfort in the subdivision. This is attested to by the several people in the subdivision that we interviewed for this publication and whose comments we have included herein.

Meter readings show that the average monthly cost of running the GSHP was \$20 during the first 12 months of monitoring. Average floor space for houses in the subdivision is 1,816 square feet, ranging from 1,134 to 2,914.

The heat pumps also contributed about half the energy needed for heating water in the houses during the winter months. Jim Maunder, Member Services Representative for the co-op, said that the savings achieved with the GSHP would pay back the additional cost of the equipment in 5 to 7 years.

Performance Better Than Expected

Dave Theisen, the developer, said he is satisfied with the way the heat pumps have performed. "The results have been substantially better than we expected," he said. Until recently, he said, most of the GSHP in the area were in 200 or so larger and more expensive houses scattered around western Montana, where they were perceived to be accessible only for the high-end market segment. The Mullan Trail Subdivision has changed that. "I think we've proved that the average home owner can have a GSHP and wants one," he said. "They are economically and environmentally sensitive," Theisen said, pointing out that environmental considerations are particularly important in a place like Missoula with a closed airshed that is susceptible to pollutant buildup.

The first 40 homes built with GSHP received an incentive from BPA, but the interest in GSHP continued after the subsidy was gone, Theisen said. Since completion of the first 40 houses, 10 more new houses in the subdivision have included GSHP.



Left to right- Jim Maunder, Missoula Electric Co-op
David Theisen, land developer
Kirk Flynn, Missoula Electric Co-op

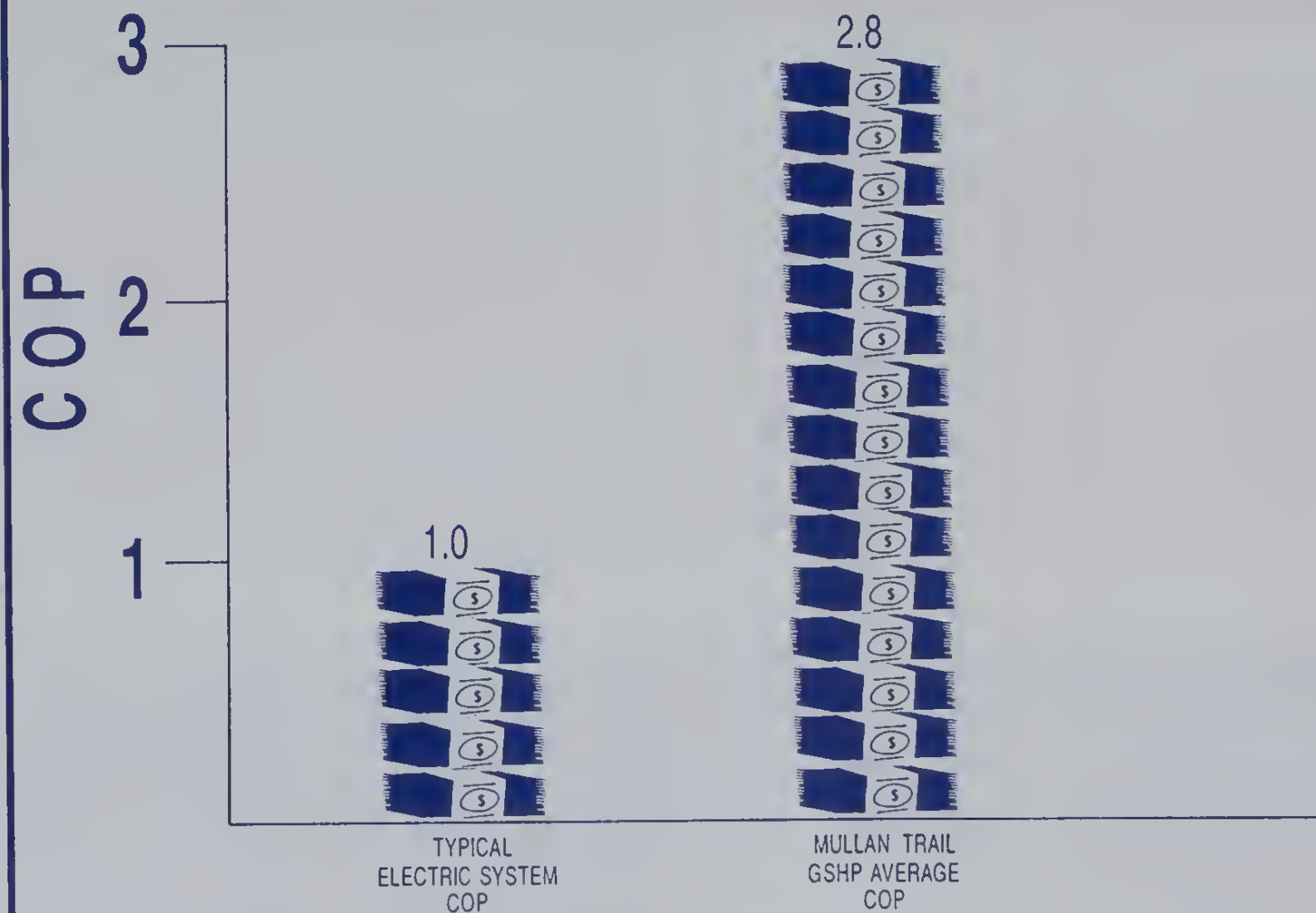
Kids Notice the Difference

Kirk Flynn, Manager of Member Services for the co-op, said people in the subdivision have been enthusiastic about the year-round comfort provided by the GSHP. The level of enthusiasm expressed for the air conditioning function has been surprising, he said. The perfect test of the air conditioning came in the hot dry summer of 1994. During those dog days of summer, residents of houses in the subdivision that did not have GSHP kept their windows open trying to cool off. In contrast, the houses with GSHP were kept cool as homeowners took advantage of the air conditioning provided by the system. The comfort provided by GSHP is most noticeable to people who move among houses with GSHP and those with different systems in the same subdivision. "Kids notice the difference," Theisen said. "They visit their friends and notice the differences between their friends' houses and their own."

Both Theisen and the co-op representatives, Maunder and Flynn, expressed satisfaction with the GSHP, and predicted that the future will find them increasingly common.

GSHP PERFORMANCE AT MULLAN TRAIL

Based on COP (Coefficient of Performance)



Understanding C O P — COP is the ratio of heating and cooling output to energy input. GSHP homeowners received \$2.80 worth of heating / cooling benefits for every \$1.00 spent on electricity to operate the systems.

ENERGY COST BREAKDOWN

12 Month Average



KEY FACTS

OWNERS: Ken and Gail Clizbe

LOCATION: Missoula

HOME SIZE: 1,635 square feet

UTILITY: Missoula Electric
Cooperative

**HEATING/COOLING
COSTS:**
Monitoring Period
March 94 - Feb. 95
\$223 (@ 4.5¢ per kWh)

SYSTEM TYPE:
Vertical Ground Loop

Ken Clizbe is an electrician, and first got interested in GSHP when he was wiring new houses in the Mullan Trail Subdivision, where most houses heat and cool with GSHP.

Until then, GSHP were a mystery to him. "I had no idea at the beginning," he said, "and I was pretty skeptical." Still, he said, he could see that the concept of using heat pump technology made sense. After he wired a few in and saw how they operated, he and his wife decided they wanted one of their own.

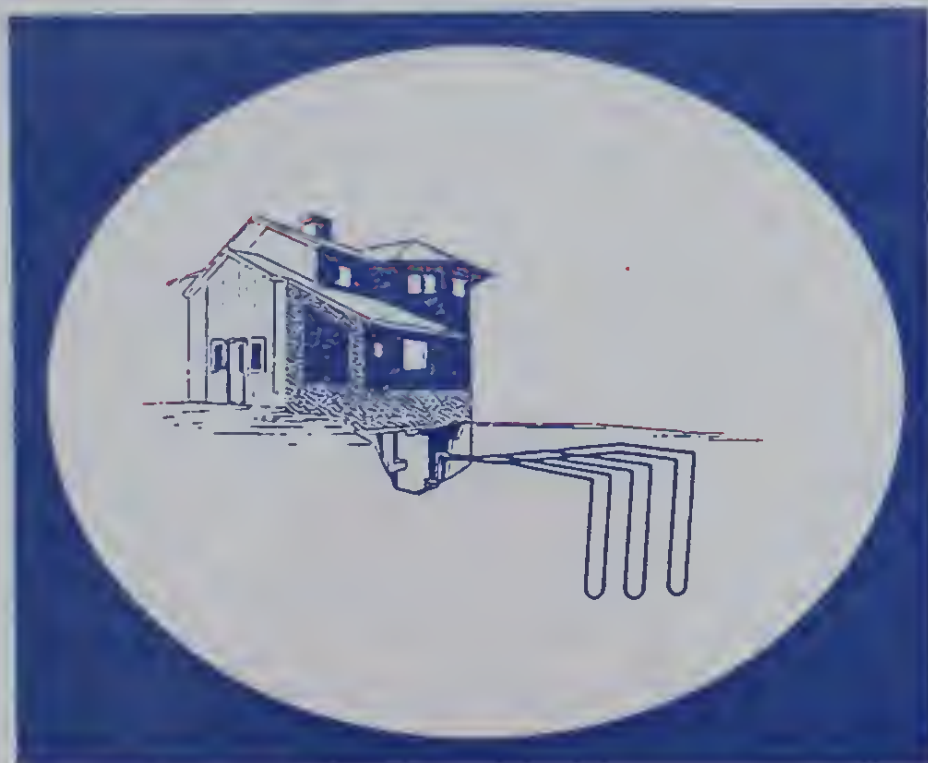
A Beloved Heat Pump

They moved into their new house in the Mullan Trail subdivision in March 1994. Ken said the new house with its GSHP, air-to-air heat exchanger, and Super Good Cents insulation package has worked out well. "The GSHP works the way it is supposed to," he said. Gail was more specific

about her feeling for the heat pump. "I love it. It's so quiet, you never even know if it's on." She contrasted the almost silent operation of the heat pump with the gas-fired forced-air furnace in their previous house. "We were always aware of the furnace. We had to keep messing with the thermostat. When the furnace came on, you'd get a blast of air." And still, some rooms would always be cold, they said.

The Remarkable Difference of One Degree

By contrast, the Clizbes' GSHP keeps all the rooms at an even temperature with no blast of heat. "We had the thermostat set at 70 degrees, and it seemed just a little too cool, so we moved it to 71. I couldn't believe that a one degree adjustment would make a difference, but it did," Ken said. "Now we leave it at 71."



During the hot dry summer of 1994, the Clizbes made good use of the air conditioning provided by their GSHP system. Ken said the air conditioning was "fantastic." Besides keeping the Clizbes cool, the GSHP took the heat it picked up inside their house and used it to heat water, thereby reducing their water heating bill.

During the first year of monitoring at the Clizbes' home the GSHP submeter recorded an average of \$21 a month in energy costs for heating and cooling their 1700 square foot home. Asked if the heat pump system had any drawbacks, they could not think of any. "I wouldn't hesitate to put one in again," Ken said.



GSHP installed in a crawlspace.

Ken and Gail Clizbe - Missoula

"I love it. It's so quiet, you never even know if it's on."

Gail Clizbe



KEY FACTS

OWNERS: Gordon and Donna LaFournaise

LOCATION: Missoula

HOME SIZE: 1,726 square feet

UTILITY: Missoula Electric Cooperative

HEATING/COOLING COSTS:

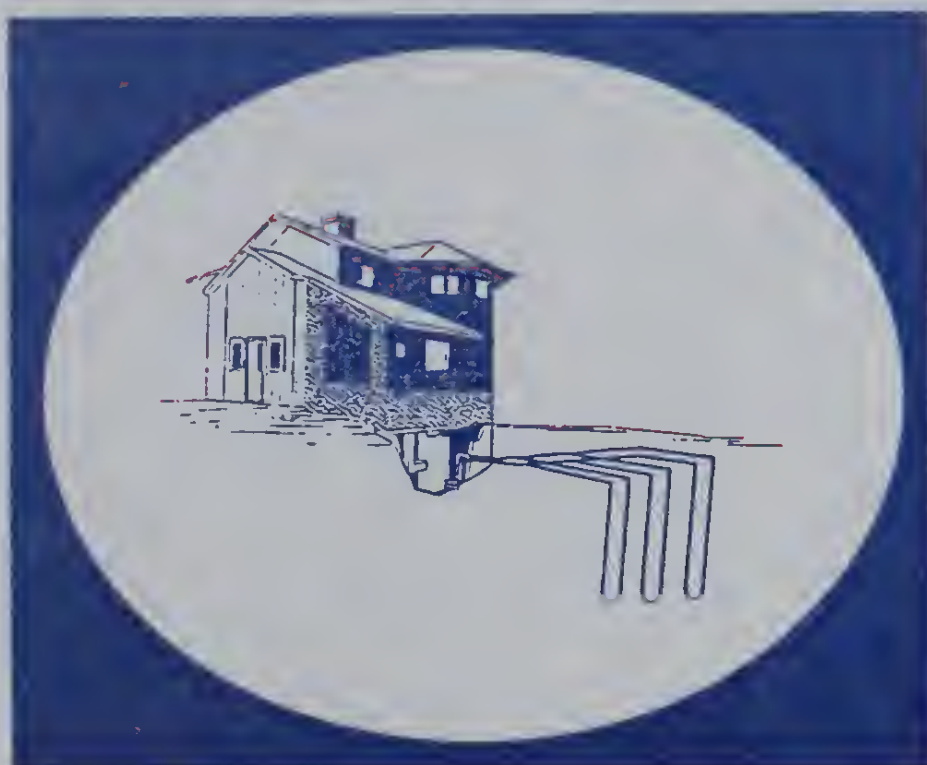
Monitoring Period
March 94 - Feb. 95
\$222 (@ 4.5¢ per kWh)

SYSTEM TYPE:
Vertical Ground Loop

Gordon and Donna LaFournaise lived in several houses over the years before they retired, but their new house outside Missoula is the first one where they could walk barefoot from one end to the other and not feel any hot or cold spots, Gordon said. "There isn't any blast of hot or cold air," Gordon said. "The heating is gradual and even all over the house."

Hotter Than the Devil, No Problem

The even heat is made possible in part by a GSHP that extracts heat from the earth through a well drilled especially for that purpose on the LaFournaise lot. A small pump circulates a heat transfer fluid from the GSHP in the LaFournaises' garage through a pipe to the well and back



to the heat pump. The heat transfer fluid picks up heat from the deep well, and the GSHP unit extracts this heat and makes it available to warm the living space and provide some hot water heating. With the flip of a switch, the system can be operated in reverse to provide air conditioning. "It was hotter than the devil outside last summer," Gordon said, "but inside our house it was a steady 69 or 70 degrees."

Gordon and Donna LaFournaise Missoula

"We're 100 percent satisfied," "I can't say enough good about it. I'd recommend it to anybody."

Gordon LaFournaise



The second element contributing to comfort in the LaFournaise house is the Super Good Cents insulation package, which goes a long way toward minimizing the amount of heating and cooling needed in the house. An air-to-air heat exchanger keeps the house ventilated.

The LaFournaises acknowledged the higher initial costs of installing a GSHP system, but pointed to low monthly bills as an argument supporting such systems. "Our bills are half to two-thirds less than they would be with a conventional system," Donna said.

100 Percent Satisfied

"We're 100 percent satisfied," Gordon said. "I can't say enough good about it. I'd recommend it to anybody."

Besides the low bills, Gordon and Donna like the environmental benefits of their heating and cooling system. "It doesn't use any fossil fuel, and there are no combustion by-products to cause pollution inside or out," Gordon said.

KEY FACTS

OWNER: Anton Hollinger

LOCATION: Seeley-Swan Valley

HOME SIZE: 4,000 square feet

UTILITY: Missoula Electric
Cooperative

SYSTEM TYPE:
Lake Loop

Big Sky Lake is off the beaten path over a hill from Salmon Lake, just south of the community of Seeley Lake. The lake, about a mile long and an eighth of a mile wide, is the center of a recreational home development, with about 60 houses ringing the perimeter.

A Good Idea Catches On

Eight of those houses are warmed and cooled with GSHP hooked up to heat exchanger loops in the lake. All these heat pumps owe their presence to a good idea Anton Hollinger had. Hollinger and his wife are part time residents at the lake in their 4,000 square foot log house. The Hollingers initially tried heating their house with electric baseboard heaters, but their heat bill for only 45 days in October and November was \$300. Not unusual given the size of their home and the high heat loss rate of log structures. In his work as a real estate developer, Anton had developed some knowledge of GSHP, and decided to put one in.

A Reasonable Payback Period

The Hollingers' GSHP system cost about \$5,000 more than a comparable propane furnace would cost, Anton said, but he expects it to pay for itself in a short period of time. Total utility bills averaged about \$70 a month year-round after the Hollingers began operating the GSHP, but jumped to about \$80 when they put in a hot tub.

Though a GSHP system is not cheap, it is a long way from being the most costly heating strategy one might adapt, Anton said. For example, one of his neighbors at Big Sky Lake started out with an oil burning heater, but it did not work well in cold weather, so he put in a propane system. This also did not work well in cold weather, so he wound up with electric baseboard heaters. "He put \$19,000 into three systems and he's still not warm," Anton said.

Though the Hollingers do not live full time in their house at Big Sky Lake, they keep the house heated to 60 to 62 degrees when they are not there. When they come to stay

in the house for awhile, Anton said, they gradually turn the thermostat up, two or three degrees at a time.

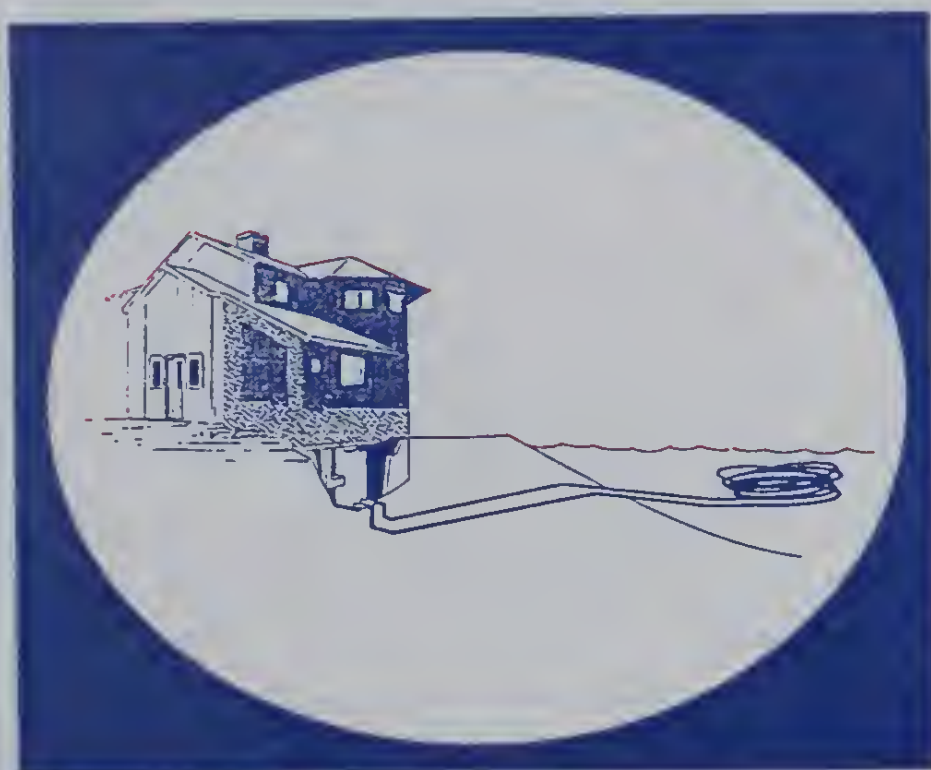
Keep Those Filters Clean

Are there any drawbacks to the system? "People have to keep the dust filters clean. Otherwise the system loses efficiency."

Long-term economy is only one of the things the Hollingers like about their GSHP. "It's quiet, you get air conditioning in the bargain, nobody has to deliver fuel, and you're not polluting anything." Besides which, he pointed out, the system has no high temperatures and there is no way for the grandchildren to burn themselves on it.

The Neighbors Get Interested

Once the Hollingers got their GSHP system operating, their neighbors around the lake got interested in it. "The neighbors couldn't believe it," Anton said. Two of the houses that were already on the lake switched to GSHP, and five houses built since have put them in at the outset.





Anton Hollinger - Seeley-Swan Valley



Big Sky Lake

" It's quiet, you get air conditioning in the bargain, nobody has to deliver fuel, and you're not polluting anything ".

Anton Hollinger

KEY FACTS

OWNER: Wayne Scammon

LOCATION: St. Ignatius

HOME SIZE: 3,072 square feet

UTILITY: Mission Valley Power

HEATING/COOLING COSTS:

Monitoring Period
March 94 - March 95
\$226 (@ 4.5¢ per kWh)

SYSTEM TYPE:

Horizontal Ground
Loop

Wayne Scammon's house has a wood stove in the basement but he doesn't expect to need it. At the time of the interview for this book, the stove was decorated with a teapot holding a flower. "It's not even hooked up," Wayne said. If the Scammons never have to use that wood stove, it will be fine with them. From 1973 until 1994, they lived in a trailer that they heated with wood and oil. They had plenty of time to think about how they would build a house, if they ever were to build one.

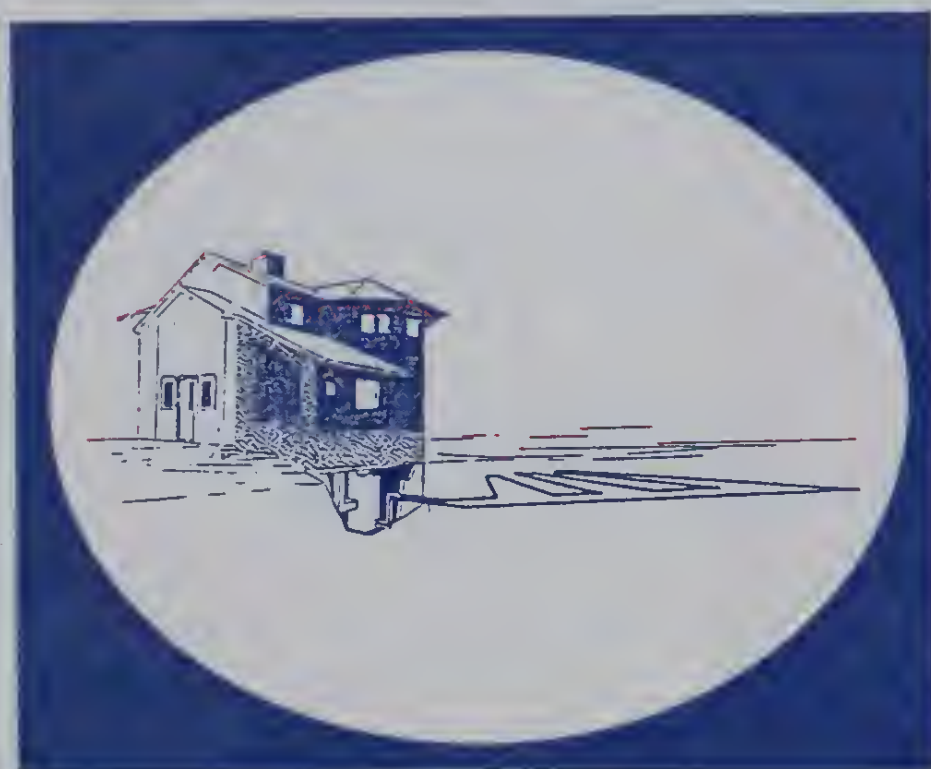
Readers Digest Plants an Idea

During this deliberation period, Wayne saw an article in the Reader's Digest about ground source heat pumps. That article, and information that Wayne picked up at a home and garden show in Missoula, convinced him that a GSHP was the way to go for heating and cooling his new house.

As it turned out, the Scammons' home site was extremely well-suited for GSHP operation. Groundwater there is near the surface, and the trenches dug to install the ground loop heat exchanger piping quickly filled with water. The heat exchanger is thus in contact with water that does not freeze year-round, which enhances the efficiency of the system. Water is a much better heat transfer medium than dry soil or gravel.

Heat Pump Could Not be Improved

The Scammons' GSHP has been operating for over a year, and they are completely satisfied with it. "I don't know how we could improve it," Wayne said. He said the system provides steady and even heating and cooling, and a big boost to water heating. Besides their regular water heater, they have a second water heater that is not hooked to an energy source, but serves as a preheat storage tank for water heated by the GSHP. The Scammons' total heating and cooling bill for the first year of operation was \$239. Their house is 3,072 square feet on two levels.



Heat Pump No Better than the Installer

Wayne said two things should be kept in mind when having a heat pump put in. First, a GSHP system is no better than the building you put it in, and second, it is no better than the person who installs it.

The Scammons did both these things right. They met the first requirement by building their house to Super Good Cents insulation and energy efficiency standards. The 2x4 stud walls are insulated with foamed-in-place urethane, and an inch of Thermax on the exterior, for an R value of 27. Ceiling penetrations were sealed with foam, and an inch of urethane was foamed in place on the upper surface of the gypsum board in the ceiling. Ceiling insulation is R-60. Low-e triple pane glazing minimizes heat loss through windows.

The Heartbreak of Poor Installation

Wayne said the installer he hired to put in his GSHP system did an excellent job. When selecting a contractor to install a GSHP, Wayne said, "You need to check references. Talk to people they've worked for." He said he knows of one GSHP system that was not properly installed, and the owner "Has nothing but headaches with it. It just blows cold air." Wayne said it is critical that a GSHP system have enough ground loop or heat exchanger surface area to provide the needed heating and cooling. If an inexperienced installer does not put in enough ground loop, he said, the system will not work as it should.

A Serendipitous Root Cellar

One unexpected bonus of the Scammon's system is a "root cellar" room in the basement. Wayne had designed the house with an insulated cold room to keep vegetables in the basement, and never gave a thought to the pipes that would run through it. The incoming and outgoing pipes that connect the ground loop to the GSHP keep the root cellar right at 50 degrees year-round, Wayne said. That may be as close as anybody comes to a free lunch.

Wayne Scammon - St. Ignatius

A Rare Investment Opportunity

Wayne said his GSHP system cost just over double what an electric furnace would cost, but he calculates that it will pay for itself in 7 years. Beyond that, it will all be gravy. "I don't get a chance to put my money into many things that pay money back," he said.

**"I don't know how we
could improve it."**

Wayne Scammon



Wayne Scammon is smiling because his wood burning days are behind him now.

KEY FACTS

OWNER: Hugh Henderson

LOCATION: Polson

HOME SIZE: 2,000 square feet

UTILITY: Mission Valley Power

SYSTEM TYPE:
Horizontal Ground
Loop

GSHP provide economical and efficient heating and cooling in a new, heavily insulated house, but how do they perform in older houses with less insulation? An example of such a house is the one owned by Hugh Henderson at the foot of the Mission Range just south of Polson. Henderson's house, about 2,000 square feet, was built in 1945, and the Hendersons have lived in it for 20 years.

The Limits of 2x4 Stud Walls

"We did what we could to insulate the place," Henderson said, "but there's a limit to what you can do with 2x4 stud walls." Henderson's walls are insulated with conventional R-11 fiberglass batts, with 12 or 14 inches of insulation in the ceiling.

Until 3 years ago, the Hendersons heated their house with a combination of wood and electric baseboard heaters. In cold months, utility bills rose over \$120. Henderson said he has plenty of firewood on his own property, so it was not that difficult to obtain. Despite the relative ease

of obtaining firewood, the Hendersons got tired of heating with it. One reason for this was the amount of dirt that goes with wood heat.

Looking for a Cleaner System

Looking for a cleaner heating system, Henderson, a professional electrician, was impressed by the performance of the GSHP systems he wired for people, and he and his wife decided to get one for themselves. Goodbye to all that dirty firewood, smoke in the house, and the other traditional side effects of wood heat.

"My wife sure doesn't miss it," Henderson said. "She threatens to bury the wood stove under so much stuff that I can never start it up again."

Besides getting rid of the wood heat mess, the Hendersons' GSHP provides the even heating and cooling that are characteristic of GSHP systems. The result has been a noticeable difference in the comfort level of their older home.



Pays for Itself, Plus Air Conditioning

Hugh Henderson is happy with his heat pump. "We figure it will pay back its cost in about 7 years," he said. The payback estimate is based on the cost of a comparable system that would burn propane. The propane system actually is not completely comparable, Hugh said, because the GSHP system includes air conditioning and helps with the water heating.

"It's fantastic when you get the air conditioner going," Hugh said. "It's nice to come into the house and turn the thermostat where you want it."



Hugh Henderson - Polson



The comfort level of the Henderson home was improved after adding a GSHP system.

" We figure it will pay back its cost in about 7 years "

Hugh Henderson

KEY FACTS

OWNERS: Kevin and Michelle Hadley

LOCATION: Kalispell

HOME SIZE: 3,600 square feet

UTILITY: Flathead Electric Cooperative

HEATING/COOLING COSTS:

Monitoring Period
June 93 - September 94
\$376 (@ 4.5c per kWh)

SYSTEM TYPE:
Vertical Ground Loop

Michelle Hadley was not an easy sell on the ground source idea. A house the Hadleys lived in previously had radiant floor heat, and Michelle wanted the same in the new house they were building. The radiant system was clean, provided a warm floor, and had relatively few hassles.

The Epitome of the Discriminating Consumer

Ken White, Energy Management Specialist with the Flathead Electric cooperative, encouraged the Hadleys to put in a ground source heat pump. He said Michelle was the "epitome of the discriminating consumer."

The Hadleys' new house is in a subdivision where most houses heat with gas, but Michelle put her foot down against that idea. "I hate uneven temperatures. With gas heat you always have this blowing, and you have to keep fooling with the thermostat."

No Turning Back Now

The Hadleys, Michelle and her husband Kevin, decided to try a GSHP, and they and their two young children have lived in their new house since June of 1993. Michelle said the GSHP system is up to her standards. "I'd never put in anything but a ground source heat pump again," she said. "If I built a house that was only 900 square feet, I'd still put in a ground source heat pump."

Michelle's husband Kevin was a building contractor until he became a firefighter in Kalispell, and Michelle worked side by side with him in building houses. "I was his laborer," she said. This work gave her more than a passing knowledge of heating and cooling systems and other aspects of the residential construction business.



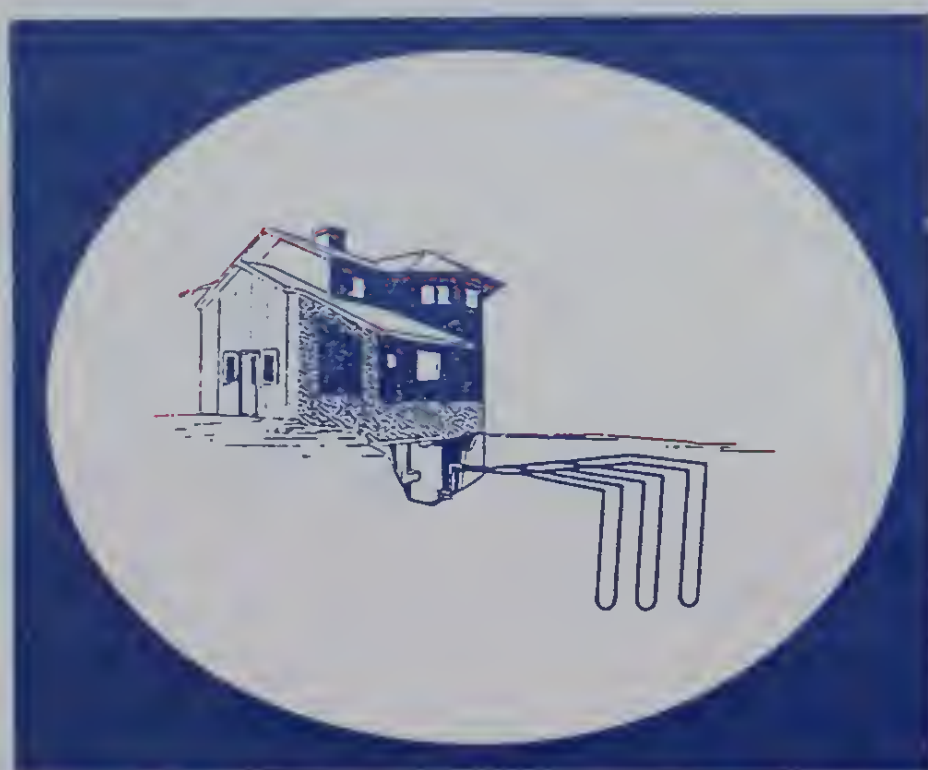
Incredibly Low Bills

The heat pump in the Hadleys' house provides even heat with no drafts and no fooling with the thermostat. "We just keep it at 71 degrees," Michelle said. The air conditioning function was especially welcome in the hot dry summer of 1994. "We ran it day and night and the bills were still incredibly low."

From the time the Hadleys' heat pump began operation in April 1993, until March 4, 1995, it used 14,536 kWh of electricity, a total of about \$725 for heating and cooling a 3,600 square foot house for nearly two years. Michelle calculates their savings at about \$100 a month over the cost of operating a conventional heating and cooling system. "It'll pay us back in 5 to 8 years, and we'll have all the advantages in the meantime," she said.

A Plethora of Benefits

Michelle sees advantages to GSHP that go beyond what most owners would notice. For example, she figures the even heat and lack of drafts has a role in her family's health. "We're never sick, we never get a cold." And there's more. "There is no dust in this house. The only



dust comes out of the clothes dryer. And I'll tell you something from a woman's point of view. You can put your furniture wherever in the hell you want it. You don't have to worry about keeping furniture or curtains away from hot registers."

GSHP House Sells Self

One advantage that some GSHP purchasers might not think of is the effect such a system has on the house's salability. A house with a ground source heat pump will sell itself, Michelle said. "Just show 'em a bill."

Kevin and Michelle Hadley - Kalispell

"It'll pay us back in 5 - 8 years, and we'll have all the advantages in the meantime."

Michelle Hadley



The Hadleys' heat pump provides all the comfort a family expects in a new home today.

KEY FACTS

OWNERS: Wayne and Barbara Ristine

LOCATION: Kalispell

HOME SIZE: 3,000 square feet

UTILITY: Flathead Electric Cooperative

HEATING/COOLING COSTS:

Monitoring Period
August 93 - February 95
\$412 (@ 4.5c per kWh)

SYSTEM TYPE:
Vertical Ground Loop

Wayne and Barb Ristine and their family came to Montana from Illinois, where heating bills can be painful. "Electricity was 13 cents a kWh," Wayne said. "It cost me as much there to run just the fan in a forced-air furnace as it costs to heat my whole house here."

The keys to these low bills, besides much cheaper electricity in Montana, are a Super Good Cents insulation and energy-efficiency package and a GSHP system. The Ristines' house is 3,000 square feet on three levels, all kept at a uniform temperature year-round by the heat pump. "When you live on three levels it makes it hard to keep the temperature even," Wayne said, adding that the GSHP nevertheless was able to do this. They don't even have to plug some heat registers to get the heat spread out, as they did in one of their previous homes, Wayne said.

Bills a Mere Pittance

Kilowatt hour meters on the GSHP reflect economical operation. From August 1993 until February 1995, the average monthly bill for heating and cooling was about \$27. The highest heating bill was \$54. The Ristines have not used their air conditioning much yet. "We turned it on three or four times," Wayne said, adding that the Flathead valley feels naturally cool to people accustomed to living in hot and humid Illinois.

The heat pump also gives the Ristines a boost in heating water, which is important, considering that they have five children still living at home. They have an extra water tank to store water heated by the heat pump. "You wind up with 100 gallons of hot water," Wayne said.



The Ristine family appreciates the even heating and low heating bills provided by their GSHP.



Indoor air is exhausted from the Ristines' house by a bathroom fan that is set to operate 15 minutes every 2 hours. Exhausted air is replaced by outside air that comes in through an "earth tube," a large diameter buried pipe. The temperature of the earth tube remains much the same all year round and warms or cools the air drawn through it.

Silence is Golden

Besides the economy and the even heating, the Ristines said they appreciate the GSHP silent operation. "In Illinois we had a pulse furnace," Wayne said, recalling the racket it made.

Wayne said that people looking for a comfortable heating and cooling system should not be put off by the high initial costs of a ground source heat pump. "They should keep in mind that paybacks are quick and will come," he said, adding that he figures the heat pump has saved him between \$1,000 and \$1,500 so far (as of spring, 1995). Prospective heat pump purchasers also can be confident that electric rates will go up in the future, increasing the savings, he said.

The Need for a Longer View

"Most people don't think ahead beyond 3 to 5 years," Wayne said, noting that a longer time frame is appropriate when considering GSHP. Even if a person only stays in a house for 7 years, which is average, the GSHP will still save them money, besides enhancing the salability of the house, Wayne said.

Long term considerations also favor the use of electricity for heating and cooling, Wayne said, because electricity prices tend to be more stable than other forms of energy, such as propane, which fluctuates considerably.

The Ristines have given a lot of thought to backup systems to keep them warm if the power should go

out. The house has two wood-burning fireplaces that could provide some heat, and Wayne purchased a generator that could power the GSHP in case of an electric outage. (Ken White of the Flathead Electric Cooperative emphasized that certain measures must be taken when connecting a heat pump to a generator, and a knowledgeable electrician should be consulted.)

Wayne and Barbara Ristine - Kalispell

Keeping an Eye on Dollars and Cents

In summary, Wayne and Barb said, they are happy with their GSHP and would not hesitate to put another one in if they were ever to build another home. "I have an engineering background," Wayne said. "I keep an eye on the dollars and cents."

The Ground Source Heat Pump has saved between \$1,000 and \$1,500.



KEY FACTS

OWNERS: Frank and Peg Gebhart

LOCATION: Kalispell

HOME SIZE: 3,600 square feet

UTILITY: Flathead Electric Cooperative

SYSTEM TYPE:
Horizontal Ground Loop



Frank and Peg Gebhart labored faithfully for 12 years to keep their wood furnace fed, but then they looked farther down the road of life and saw something else there. It was a ground source heat pump. Nowadays, Frank sometimes wakes up early in the morning and hears just the faintest air movement as the heat pump kicks on. He remembers all those other mornings when he had to get up in a cold house and roll a cold log into the cold furnace, and he smiles.

The Beginnings of a Smile

This smile had its beginnings in 1992 after the Gebharts noticed that the fun of gathering their own firewood was wearing off. Frank said he saw some ads that the Flathead Electric Cooperative had placed in the local newspaper promoting ground source heat pumps. Investigation of

these systems suggested they would be just what Frank and Peg needed. They had their GSHP system installed that same year and it has been amazing them ever since.

"It's unreal," Peg said. She explained that there is absolutely nothing to worry about when you heat and cool with a GSHP. No hot spots where a grandchild could be injured or adjacent materials set on fire. No air pollution, indoor or out, no flame, nothing. Operation is safe and effortless, causes no pollution, and works for the long run. "It should be good for 60 or 70 years," Frank said.

Frank detailed his routine for the operating the system. "I just set it at 72 degrees and flip the switch from heat to cool in the summer."



Trenching work prior to installing a horizontal ground loop.

When the Gebharts are away from home for a period, their GSHP system keeps their house at a preset temperature with the same economical operation it displays when they are home.

Flathead Electric records of the Gebhart's energy use indicate their GSHP system has used a year-round average of about \$50 worth of electricity per month since it was installed. This is in a house with 3,600 square feet on two floors, with only slight enhancement of the relatively light insulation that was current when it was built. Newer houses with more insulation would use much less energy, as indicated elsewhere in this publication.

As for Frank and Peg Gebhart, they could hardly be happier than they are with their GSHP system. "We can't say enough good about it," they said.

**"We can't say
enough good
about it"**

Frank and Peg Gebhart

Frank and Peg Gebhart - Kalispell



KEY FACTS

OWNERS: Stan and Bonnie Williams

LOCATION: Eureka

HOME SIZE: 3,260 square feet

UTILITY: Lincoln Electric Cooperative

HEATING/COOLING COSTS:

Monitoring Period
March 94 - February 95
\$448 (@ 4.5¢ per kWh)

SYSTEM TYPE:
Direct Expansion

Stan Williams, a lineman for Lincoln Electric Cooperative, was not sure that a GSHP was the right sort of heating system for his new house. "I like wood heat," he said. "When I come in cold from working, I like backing up to a hot wood stove."

Another Heat Pump Convert

After a year in his new house with a GSHP, however, Stan says he's a convert to the GSHP fan club. "I'd do it again without a doubt," he said.

Stan and his wife Bonnie recalled the drawbacks of wood heat. Besides dirt and smoke and uneven heating, a wood heat system requires some sort of backup to keep the house warm while nobody is home. "You can't very well let the place freeze up," Stan said. At their previous home, Stan and Bonnie had electric baseboard heaters to back up their wood heat. Backup heaters are no longer necessary, however, because the Williams' heat pump

keeps their house at an even temperature year-round, night and day, whether anyone is home or not. "It's nice coming home to a warm house," Stan said.

Low Bills, No Bum Steer

The Williams initially became interested in GSHP technology through friends who put them in and liked them. Besides the clean even heat, the Williams and their friends like the economical operation of their system. During the first 12 months the Williams' average bill for heat pump operation was \$26.25, Stan said. Their December bill was the highest, \$50. Their lowest bills were in July and August, \$19 for each month.

Based on his experience at his previous house, Stan calculated that the heat pump replaced 6 cords of wood (at \$50-\$100 each) and \$200 to \$300 in electricity per year.



A Good Investment

Although more expensive to purchase, Stan said, a GSHP is “a good investment.” He pointed out that a GSHP system provides central air conditioning and a boost for water heating besides space heat. Any cost comparisons between GSHP and other systems thus need to include the cost of a separate air conditioning system that would have to be added to a conventional heating system to provide equivalent service, he said.

The Williams' house includes 3,280 square feet of living space on two levels, insulated to Super Good Cents standards.

**“ I'd do it again
without a doubt ”**

Stan Williams

Stan and Bonnie Williams - Eureka



KEY FACTS

OWNERS: J. W. and Jeannette Hammock

LOCATION: Fortine

HOME SIZE: 1,500 square feet

UTILITY: Lincoln Electric Cooperative

HEATING/COOLING COSTS:

Monitoring Period
Dec 93 - Nov 94
\$168(@ 4.5c per kWh)

SYSTEM TYPE:
Direct Expansion

When J.W. and Jeannette Hammock decided to build their retirement home near Fortine (south of Eureka), they had a whole lifetime of experience to guide their selection of a heating and air conditioning system. The experience said "ground source heat pump," despite the skepticism of friends and relatives. "They told us, 'You'll never get your money back,' but that wasn't what we were mainly interested in anyway." What they were mainly interested in was comfort, which they knew would be provided by a GSHP system.

An Appreciation of Comfort

The Hammocks appreciate comfort because they have not always had it. They spent the bulk of their working years in or near the deserts of Arizona and California where the enemy is unrelenting summer heat and high humidity, rather than cold. Living in trailers in their early married years and then graduating through a series of houses, the Hammocks were ahead of their neighbors in making their homes comfortable. A crucial element of the solution was insulation, J.W. said. When the Ham-

mocks contracted to have a house built for them near El Centro, California, just north of the Mexican border where summer temperatures are about the same as in a suburb of hell, according to some, the contractor balked at insulating the walls, saying it was not necessary. He reluctantly put 3 1/2 inches of loose insulation in the ceiling, but even this settled to 2 inches, J.W. said.

Homeowner Insulates, Cools off, Saves Money

J.W. insulated the walls himself, and when the scorching heat and high humidity came around, the Hammocks had the lowest energy bills of anybody in the vicinity, because their insulation kept the cool in and the heat out.

Their new retirement house, 1,500 square feet on one level, is built with insulation to Super Good Cents standards which helps maintain the even comfortable temperatures the Hammocks appreciate.

The key to economical comfort in a house is the proper amount of insulation in combination with an efficient



heating and cooling system. Before the Hammocks came to Montana to live, J.W. read about GSHP in Consumer's Guide magazine, and they sounded good to him. His work as a construction inspector had made him familiar with the principles of refrigeration, which are the basis for heat pump operation, and he liked the idea of extracting heat from the ground and using it in his house. The idea took some time to grow on him though.

Narrow Escape from Wood Heat

"If I'd built this place 10 years ago I'd have heated with wood," he said. "I was not smart enough to realize you can't cut wood when you're old." J.W. said he calculated



J.W. and Jeannette Hammock - Fortine

"We'd do it again in a minute"

J.W. Hammock

that if he cut a cord of wood each weekend during the summer, it would be barely enough to keep his house warm during the winter. The idea of sacrificing all those weekends did not appeal to the Hammocks.

"We knew we wanted central heat and air," Jeannette said, and they decided to go with a GSHP. One consideration in choosing the GSHP system was the likelihood of higher energy prices in the future. In El Centro, California, where they lived in the late 50s, electricity was cheap, they said, and when they moved to Sacramento later, it was even cheaper. Over the years, this changed, they said, and the price of electricity increased.

Energy Costs in the Future Will Rise

All forms of energy are likely to rise gradually over time and increase the cost of heating and cooling our homes. When that happens, the Hammocks and other owners of energy conserving ground source heat pumps will grin all the way to the bank. The Hammocks participate in a program with Lincoln Electric Cooperative to monitor the energy usage of their GSHP system. In the months since

the Hammocks moved into their house in November 1993, their highest monthly heating bill was \$30, for January 1995. Their lowest bill was 42 cents, for September 1994. The bill might have been higher that month, the Hammocks said, but relatives from the south were visiting and they started getting cold if the temperature in the house dropped to 80 degrees. "We didn't get to use our air conditioner much that month," Jeannette said.

Do It Again in a Minute

Jeannette and J.W. mince no words when they talk about their heat pump. "We'd do it again in a minute," they said emphatically, "unless something better comes along in the meantime."

The Hammocks said they were not intimidated by the higher initial costs of GSHP systems. Against the clear memory of those sweltering days and nights in the suburbs of hell, "the price of comfort is money well spent," they said.

Montana Department of Environmental Quality
Energy Division
1520 East Sixth Avenue
Helena, Montana 59620-2301

7,000 copies of this public document were published at an estimated cost of .60 cents per copy, for a total cost of \$4,200.00, which includes \$4,200.00 for printing and \$00.00 for distribution.